1. An engineered chimeric protein whose interaction with a target biomolecule is regulated by the presence, concentration, or absence of a ligand, the protein comprising:

an interaction domain that binds to a target biomolecule; and

a ligand binding domain comprising a peptide that binds to a preselected ligand, selection of said peptide for binding being informed by a recombinant display technique,

wherein said peptide comprises an amino acid sequence selected to permit, and is bonded to said interaction domain at a position selected to permit, a change in the chimeric protein upon binding of the ligand to said ligand binding domain, said change regulating binding of the interaction domain to the target biomolecule.

2. A chimeric protein as in claim 1, wherein the recombinant display technique is selected from the group consisting of phage display, single chain antibody display, retroviral display, bacterial surface display, yeast surface display, ribosome display, two-hybrid techniques, three-hybrid techniques, and derivatives thereof.

3. A chimeric protein as in claim 1, wherein the peptide is no more than one hundred amino acids in length.

4. An engineered chimeric protein whose interaction with a target biomolecule is regulated by the presence, intensity, or absence of a stimulus, the chimeric protein comprising:

an interaction domain that binds to a target biomolecule; and

a detection domain comprising a peptide that recognizes a stimulus,

said peptide comprising an amino acid sequence no more than one hundred amino acids in length selected to permit, and being bonded to said interaction domain at a position selected to permit, a change in the chimeric protein upon receipt of the stimulus, said change regulating binding of said interaction domain to the target biomolecule.

5. A chimeric protein as in claim 4, wherein selection of said peptide is informed by a recombinant display technique.

6. A chimeric protein as in claim 4, wherein the stimulus is a perturbation of a thermodynamic state.

7. A chimeric protein as in claim 4, wherein the stimulus comprises electromagnetic radiation.

8. A chimeric protein as in claim 3 or 4, wherein the peptide is no more than eighty amino acids in length.

9. A chimeric protein as in claim 8, wherein the peptide is no more than sixty amino acids in length.

10. A chimeric protein as in claim 9, wherein the peptide is no more than forty amino acids in length.

11. A chimeric protein as in claim 10, wherein the peptide is no more than twenty amino acids in length.

12. A chimeric protein as in claim 1, 3, or 4, wherein the target biomolecule is a DNA sequence operably linked to a target gene and said protein regulates expression of the target gene.

13. A chimeric protein as in claim 1, 3, or 4, wherein the target biomolecule is a protein which modulates transcription of a target gene.

14. A chimeric protein as in claim 13, wherein the target biomolecule is a transmembrane protein.

15. A chimeric protein as in claim 1, 3, or 4 further comprising a dimerization domain.

16. A chimeric protein as in claim 15, wherein dimerization of the chimeric protein is required for efficient binding to the target biomolecule, and wherein the change in the chimeric protein regulates dimerization thereof.

17. A chimeric protein as in claim 1, 3, or 4, wherein the interaction domain comprises a leucine zipper.

18. An engineered chimeric protein for modulating transcription of a target gene based on the presence, concentration, or absence of a ligand, the chimeric protein comprising:

an interaction domain that binds to a DNA sequence operably linked to a target gene to regulate expression of the target gene; and

a ligand binding domain comprising a peptide that binds to a ligand, selection of the peptide for binding being informed by a recombinant display technique,

wherein said peptide comprises an amino acid sequence selected to permit, and is peptide bonded to said interaction domain at a position selected to permit, a change in the chimeric protein upon binding of the ligand to said ligand binding domain, said change regulating binding of the interaction domain to the DNA sequence thereby to modulate transcription of the target gene.

19. A chimeric protein as in claim 18, wherein the recombinant display technique is selected from the group consisting of phage display, single chain antibody display, retroviral display, bacterial surface display, yeast surface display, ribosome display, two-hybrid techniques, three-hybrid techniques, and derivatives thereof.

20. A chimeric protein as in claim 18, wherein the peptide is no more than one hundred amino acids in length.

21. An engineered chimeric protein for modulating transcription of a target gene based on the presence or absence of a stimulus, the chimeric protein comprising:

an interaction domain that binds to a DNA sequence operably linked to a target gene to regulate expression of the target gene; and

a detection domain comprising a peptide that is responsive to a stimulus,

said peptide comprising an amino acid sequence no more than one hundred amino acids in length selected to permit, and being peptide bonded to said interaction domain at a position selected to permit, a change in the chimeric protein upon receipt of the stimulus, said change regulating binding of said interaction domain to the DNA sequence thereby to modulate transcription of the target gene.

22. A chimeric protein as in claim 21, wherein selection of said peptide is informed by a recombinant display technique.

23. A chimeric protein as in claim 21, wherein the stimulus is a perturbation of a thermodynamic state.

24. A chimeric protein as in claim 21, wherein the stimulus comprises electromagnetic radiation.

25. A chimeric protein as in claim 20 or 21, wherein the peptide is no more than eighty amino acids in length.

26. A chimeric protein as in claim 25, wherein the peptide is no more than sixty amino acids in length.

27. A chimeric protein as in claim 26, wherein the peptide is no more than forty amino acids in length.

28. A chimeric protein as in claim 27, wherein the peptide is no more than twenty amino acids in length.

29. A chimeric protein as in claim 18, 20, or 21, wherein the interaction domain comprises a helix-turn-helix motif.

30. A chimeric protein as in claim 29, wherein the interaction domain is derived from lambda repressor.

31. A chimeric protein as in claim 18, 20, or 21, wherein the interaction domain comprises a zinc finger motif.

32. A chimeric protein as in claim 18, 20, or 21 further comprising a dimerization domain.

33. A chimeric protein as in claim 32, wherein dimerization of the chimeric protein is required for efficient binding to the DNA sequence, and wherein the change in the

chimeric protein regulates its dimerization, thereby regulating binding to the DNA sequence.

34. A nucleic acid encoding a chimeric protein as in claim 1, 3, 4, 18, 20, or 21.

35. A vector comprising a nucleic acid as in claim 34.

36. An engineered sensor cell comprising:

a chimeric protein as in claim 18, 20, or 21 wherein the target gene comprises a reporter gene whose expression has an effect detectable outside the sensor cell.

37. A sensor cell as in claim 36, wherein the effect detectable outside the sensor cell is a color change.

38. A sensor cell as in claim 36, wherein the effect detectable outside the sensor cell is fluorescence.

39. A sensor cell as in claim 36, wherein the effect detectable outside the sensor cell is secretion of a detectable molecule.

40. A sensor cell as in claim 36, wherein the effect detectable outside the sensor cell is presentation of a detectable molecule on an exterior surface thereof.

41. A sensor cell as in claim 36, wherein expression of the reporter gene modulates transcription of an additional gene, said additional gene causing the effect detectable outside the sensor cell.

42. An engineered bistable genetic switch comprising:

a promoter operably linked to an output gene, the expression of which is detectable as an output of the cell,

first and second stimulus responsive proteins which respectively modulate transcription of first and second genes to produce first and second translation products having opposing effects on the activity of said promoter,

at least one of said first and second stimulus responsive proteins being a chimeric protein as in claim 18, 20, or 21.

43. A bistable switch as in claim 42, wherein the first translation product effects repression of the level or activity of the second stimulus responsive protein and the second translation product effects repression of the level or activity of the first stimulus responsive protein.

44. A bistable switch comprising a cell containing a promoter operably linked to an output gene, the expression of which is detectable as an output of the cell, the promoter comprising mutually exclusive binding sites for a pair of expression modulating proteins, at least one of which is an engineered chimeric protein as in claim 18, 20, or 21.

45. An engineered biological logic gate comprising a cell comprising:

an output gene the expression of which defines at least a first state and a second state, and is controlled by an expression control DNA, or an expression control protein, comprising at least two sites for binding expression modulating proteins,

first and second proteins responsive to input stimuli, which proteins bind to a said binding site, or modulate expression of another gene product which in turn effects binding to a said binding site, thereby to modulate expression of said output gene,

each of said input stimuli responsive proteins having at least a first state and a second state, the state of said output being determined by the states of said first and second inputs,

at least one of said first and second input stimuli responsive proteins comprising a chimeric protein as in claim 18, 20, or 21.

46. An engineered biological logic gate as in claim 45 selected from the group consisting of an AND gate, an OR gate, a NOR gate, and a NAND gate.

47. An engineered biological logic circuit comprising at least first and second logic gates as in claim 45, wherein the state of the output of said first logic gate determines the state of an input of said second logic gate.

48. An engineered biological logic gate comprising a cell comprising:

first and second output genes, the expression of which collectively define an output biochemical activity of said cell and is respectively controlled by a molecule comprising an expression control DNA or an expression control protein,

first and second proteins, each of which bind to a said molecule, or modulate expression of another gene product which in turn effects binding to a said molecule, thereby to modulate expression of said respective output genes,

each of said first and second proteins producing, in response to a biophysical stimulus, at least a first state and a second state of expression of said respective output genes,

the output biochemical activity of said cell being dependant on the states of expression of said output genes modulated by said stimuli,

at least one of said first and second proteins being a chimeric protein as in claim 18, 20, or 21.

49. An engineered biological logic gate as in claim 48 selected from the group consisting of an AND gate, an OR gate, a NOR gate, and a NAND gate.

50. An engineered biological logic circuit comprising at least first and second logic gates as in claim 48 wherein the state of the output of said first logic gate determines the state of an input of saidsecond logic gate.

51. An engineered cellular system comprising:

a sensor cell as in claim 36; and

a downstream cell comprising a receptor that is responsive to expression of said reporter gene to change a property of the downstream cell.

52. A cellular system as in claim 51, wherein the location of said downstream cell changes in response to expression of said reporter gene.

53. A cellular system as in claim 51, wherein the viability of said downstream cell changes in response to expression of said reporter gene.

54. A cellular system as in claim 51, wherein secretion of a molecule by said downstream cell changes in response to expression of said reporter gene.

55. A cellular system comprising a trigger cell and a sensor cell,

the trigger cell, in response to a first stimulus, transmitting a second stimulus to the sensor cell,

the sensor cell comprising (i) a DNA sequence operably linked to a target gene to modulate expression of the target gene; and (ii) a chimeric protein responsive to a second stimulus said chimeric protein comprising an interaction domain that binds to said DNA sequence and a detection domain comprising a peptide that is responsive to said second stimulus,

said peptide comprising an amino acid sequence selected to permit, and being bonded to said interaction domain at a position selected to permit, a change in the chimeric protein upon receipt of the second stimulus, said change regulating binding of the interaction domain to the DNA sequence thereby to modulate transcription of the target gene.

56. A cellular system as in claim 55, wherein the first stimulus is a concentration change of a component of a solution in contact with said trigger cell.

57. A cellular system as in claim 55, wherein the first stimulus is a perturbation of a thermodynamic state.

58. A cellular system as in claim 55, wherein the first stimulus comprises electromagnetic radiation.

59. A cellular system as in claim 55, wherein the second stimulus is a ligand which is transported to said sensor cell.

60. A cellular system as in claim 59, wherein, in response to the second stimulus, the sensor cell changes a concentration of a ligand.

61. A cellular system as in claim 60, wherein, in response to the second stimulus, the sensor cell increases a rate of synthesis of a ligand.

62. A cellular system as in claim 60, wherein, in response to the second stimulus, the sensor cell decreases a rate of degradation of a ligand.

63. A cellular system as in claim 55, wherein the second stimulus is a biophysical change.

64. A cellular system as in claim 63, wherein the second stimulus is a ligand.

65. A cellular system as in claim 64, wherein the trigger cell transmits the ligand by secreting the ligand.

66. A cellular system as in claim 64, wherein the trigger cell transmits the ligand by displaying the ligand on an exterior surface thereof.

67. A method of engineering a ligand-responsive chimeric protein construct that modulates gene expression responsive to the presence, concentration, or absence of a preselected ligand, the method comprising the steps of:

identifying one or more amino acid sequences that bind a preselected ligand;

designing, based on the one or more amino acid sequences, an engineered peptide that binds the preselected ligand;

selecting an interaction domain which binds to a target biomolecule to modulate expression of a gene;

identifying a permissive position within or adjacent the interaction domain at which insertion of a heterologous peptide permits retention of binding of the interaction domain to the target biomolecule and conserves expression modulation activity; and

synthesizing a construct comprising the engineered peptide fused to the interaction domain at the permissive position,

thereby to produce a construct wherein binding of the ligand to the engineered peptide causes a change in said chimeric protein, the change regulating binding of the interaction domain to the target biomolecule and expression.

68. A method as in claim 67, wherein the peptide identifying step is done using a recombinant display technique selected from the group consisting of phage display, retroviral display, bacterial surface display, yeast surface display, ribosome display, two-hybrid techniques, three-hybrid techniques, and derivatives thereof.

69. A method as in claim 67, wherein the engineered peptide is among the one or more amino acid sequences identified using the recombinant display technique.

70. A method as in claim 67, wherein the engineered peptide reflects a consensus sequence derived from the one or more amino acid sequences identified.

71. A method as in claim 67, wherein the engineered peptide is no more than one hundred amino acids in length.

72. A method of engineering a stimulus-responsive chimeric protein construct which modulates expression of a preselected gene, the method comprising the steps of:

identifying a stimulus-responsive peptide of no more than one hundred amino acids in length;

selecting an interaction domain capable of binding to a target biomolecule to modulate transcription of a preselected gene;

identifying a permissive position within or adjacent the interaction domain at which insertion of a heterologous peptide permits binding of the interaction domain to the target biomolecule; and

synthesizing a construct comprising the stimulus-responsive peptide fused to the interaction domain at the permissive position,

thereby to produce a construct wherein recognition of the stimulus causes change in said chimeric protein, the change regulating binding of the interaction domain to the target biomolecule.

73. A method as in claim 71 or 72, wherein the engineered peptide is no more than eighty amino acids in length.

74. A method as in claim 71 or 72, wherein the engineered peptide is no more than sixty amino acids in length.

75. A method as in claim 71 or 72, wherein the engineered peptide is no more than forty amino acids in length.

76. A method as in claim 71 or 72, wherein the engineered peptide is no more than twenty amino acids in length.

77. A method as in claim 67 or 72, wherein the permissive position is identified using stereochemical data about the three-dimensional structure of the interaction domain.

78. A method as in claim 67 or 72, wherein the permissive position is identified using mutational data about the interaction domain.

79. A method of engineering a stimulus-responsive chimeric protein construct, the method comprising the steps of:

identifying, from a database of information, a stimulus-responsive protein;

selecting an interaction domain capable of binding to a target biomolecule;

identifying a permissive position within or adjacent the interaction domain at which insertion of a heterologous peptide permits retention of binding of the interaction domain to the target biomolecule; and

synthesizing a construct comprising the stimulus-responsive protein, or a peptide derivative thereof, fused to the interaction domain at the permissive position,

thereby to produce a construct wherein receipt of the stimulus by the stimulus-responsive protein, or a peptide derivative thereof causes change in said chimeric protein, the change regulating binding of the interaction domain to the target biomolecule.

80. A method for identifying a nucleic acid encoding a stimulus-responsive chimeric protein, the method comprising the steps of:

providing a library of nucleic acids encoding chimeric proteins comprising an interaction domain and a detection domain that recognizes a stimulus;

introducing into each of a plurality of cells a nucleic acid from the library, each of the cells comprising a target biomolecule that binds to the interaction domain of the chimeric protein and a reporter gene whose expression has an effect detectable outside the cell, wherein the target biomolecule is selected from the group consisting of a nucleic acid operably linked to the reporter gene and a protein capable of modulating transcription of the reporter gene;

maintaining the cells under conditions permitting expression of the chimeric proteins encoded by the nucleic acids;

exposing the cells to the stimulus;

identifying a cell for which expression of the reporter gene is modulated by the stimulus; and

isolating the nucleic acid encoding the stimulus-responsive chimeric protein from the cell.

81. A method of detecting a molecule in a solution, the method comprising the steps of:

exposing a sensor cell as in claim 36 to the solution, wherein a concentration of the molecule in the solution modulates exposure of the chimeric protein of the sensor cell to the stimulus or ligand causing the change in the chimeric protein; and

detecting the effect of expression of the reporter gene.

82. A method as in claim 81 wherein the molecule is a contaminant.

83. A method of detecting an etiologic agent in a solution, the method comprising the steps of:

exposing a sensor cell as in claim 36 to the solution, wherein presence of the etiologic agent in the solution modulates exposure of the chimeric protein of the sensor cell to the stimulus or ligand causing the change in the chimeric protein; and

detecting the effect of expression of the reporter gene, thereby to detect the etiologic agent.

84. A method of detecting a disease, the method comprising the steps of:

administering to a patient a sensor cell as in claim 36, wherein the presence of a marker characteristic of the disease in the patient modulates exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein; and

detecting the effect of expression of the reporter gene, thereby to detect the presence of the disease in the patient.

85. A method of detecting a disease marker indicative of the presence of a disease in a patient, the method comprising the steps of:

exposing a sample from a patient with a sensor cell as in claim 36, wherein the presence of the disease marker in the sample modulates exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein; and

detecting the effect of expression of the reporter gene, thereby to detect the presence of the disease marker in the sample.

86. A method of treating a patient, the method comprising the steps of:

administering to the patient a sensor cell as in claim 36, wherein presence of an abnormal state near the sensor cell modulates exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein, and wherein the effect of expression of the reporter gene reduces a danger associated with the abnormal state.

87. A method as in claim 86, wherein the abnormal state is a malignant or premalignant cell and wherein the effect of expression of the reporter gene reduces viability or reproduction of the malignant or premalignant cell.

88. A method as in claim 86, wherein the abnormal state is a protein plaque associated with a disease, and wherein the effect of expression of the reporter gene exposes the protein plaque to a protease that attacks the protein plaque.

89. A method as in claim 86, wherein the abnormal state is the presence of an etiologic agent, and wherein the effect of expression of the reporter gene releases a chemical or biochemical species that renders the etiologic agent less harmful.

90. A method as in claim 89, wherein the chemical or biochemical species kills or digests the etiologic agent.

91. A method of monitoring a fermentation process, the method comprising the step of:

contacting a solution from the fermentation process with a sensor cell as in claim 36, wherein a concentration of a component of the solution modulates exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein; and

detecting the effect of expression of the reporter gene, thereby to detect data indicative of the concentration of the component.

92. A method of screening drug candidates, the method comprising the steps of:

providing a sensor cell as in claim 36, wherein the activity of a biochemical pathway to be targeted by a drug modulates exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein;

changing a concentration of a drug candidate in contact with the sensor cell; and

detecting the effect of expression of the reporter gene, thereby to identify drug candidates that affect the biochemical pathway to be targeted.

93. A method of identifying a nucleic acid encoding a molecule with a desired biochemical activity, the method comprising the steps of:

providing a library of nucleic acids encoding molecules;

introducing into each of a plurality of cells a nucleic acid from the library, each of the plurality of cells being a sensor cell as in claim 36, wherein exposure of the chimeric protein to the stimulus or ligand causing the change in the chimeric protein is modulated by the desired biochemical activity;

maintaining the cells under conditions permitting expression of the molecules encoded by the nucleic acids;

identifying a cell expressing the reporter gene at a level indicative of the presence of the desired biochemical activity in the cell; and

isolating the nucleic acid encoding the molecule with the desired biochemical activity from the cell.

94. A method of positioning a cell, the method comprising the steps of:

maintaining a sensor cell as in claim 36 under conditions permitting expression of the chimeric protein,

exposing the sensor cell to a position-dependent stimulus regulating the chimeric protein, thereby causing position-dependent modulation of expression of the reporter gene, wherein an effect of expression of the reporter gene is modulation of cellular

movement, thereby to regulate cellular position in response to the position-dependent stimulus.

95. A method of positioning a cell as in claim 94, wherein the position-dependent stimulus is a concentration gradient of ligand.

96. A method of patterned molecular synthesis using a cell-based synthesizer, the method comprising the steps of:

maintaining a sensor cell as in claim 36 near a surface of a substrate and under conditions permitting expression of the chimeric protein,

exposing the sensor cell to a position-dependent stimulus regulating the chimeric protein, thereby causing position-dependent modulation of expression of the reporter gene, wherein an effect of expression of the reporter gene is localized deposition of a compound on the surface of the substrate, thereby to induce position-dependent deposition of the compound.

97. A method as in claim 96, wherein the position-dependent stimulus is a concentration gradient of ligand.